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ABSTRACT

Using student ability, measured by grade point average and cognitive structure, as measured by the number of high school and college courses in science and mathematics, as predictor variables, the investigator attempted to determine the reliability of the use of advance organizers to enhance the retention of meaningful concepts. Students enrolled in a required course, Physical Science for Elementary Teachers, were the participants and were randomly assigned to one of three treatment groups. Group 1 received an investigator-developed comparative advance organizer prior to instruction in the metric system; group 2, an investigator-written historical account of its development; and group 3 received no prior instruction and was used for control purposes only. All participants within each group were subdivided according to ability and cognitive structure. The McFee Metric Test, the instrument used as a pretest, the study of experimental introductory passages, participation in learning activities, posttesting, and delayed posttesting were incorporated into the study. A 2 x 3 analysis of variance was used and when significant F ratios were obtained, the Scheffe Test was used in a post hoc partitioning of the sum-of-squares. Results suggested that the comparative advance organizers have potential that needs to be more fully utilized. (Author/EB)

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THE EFFECTIVENESS OF A COMPARATIVE ADVANCE ORGANIZER IN THE LEARNING AND RETENTION OF METRIC SYSTEM CONCEPTS

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INTRODUCTION

As a student progresses through school, he often is faced with the necessity of learning meaningful verbal material. Ausubel suggests that learning meaningful verbal material, whether totally new to the learner or related to previously learned conepts, can be facilitated by the use of advance organizers. Advance organizers are abstract, general, and inclusive statements presented prior to new learning tasks to provide specific, relevant anchoring ideas in the learner's cognitive structure.[1]

The fucntion of an advance organizer is to serve as a bridge between what the learner already knows and what he needs to know before he can successfully learn the task at hand. Ausubel indicated that this bridging function can be accomplished using an expository advance organizer for those learning situations where the material to be learned is totally new to the learner and that a comparative advnace organizer can accomplish this bridging function for material that is related to concepts previously learned. While both advance organizers provide ideational anchoring or scaffolding, the comparative advance organizer has the additional function of increasing the discriminability of the material to be learned from similar, and often conflicting, ideas already fixed in the learner's cognitive structure.[2]

In the learning of meaningful verbal material, advance organizers can enhance the acquisition of new concepts by nonarbitrarily and substantively anchoring new concepts to ideas already in the learner's cognitive structure. The anchorage provided by the advance orgnaizer acts to protect the newly-learned concepts from the interfering effects of other material which may be introduced prior to or following the learning experience.[3]

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Ausubel, Stager, and Gaite[4] suggest that advance organizers enhance the retention of meaningful verbal material by strengthening the discriminability of the material from those anchoring concepts which are already present in the learner's cognitive structure. This increased discriminability counteracts the process whereby the material can no longer be distinguished from the ideational structure in which it was embedded which would result in forgetting.

Some investigations of the effectiveness of advance organizers, such as those by Allen[5] and Schultz,[6] have indicated that advance organizers are more likely to be effective for students of lesser ability and for students whose cognitive structure is deficient. Cognitive structure is defined as the previously acquired knowledge in a particular field which is relevant for the assimilation of another learning task in the same field.[7] These results suggest that the student's ability, as measured by his grade point average (GPA), and the extent of his existing cognitive structure, as measured by the number of high school and college courses in science and mathematics that the subject has completed, are also factors worth investigating.

PURPOSE

The purpose of this study was to determine the effectiveness of a comparative advance organizer in the learning and retention of metric system concepts with respect to (1) student ability--measured by the subject's grade point average; (2) cognitive structure--the number of high school and college courses in science and mathematics completed; and (3) treatment group--comparison of advance organizer, historical introduction, and/or control group.

PROCEDURE

The subjects used in this study were students who had enrolled in Physical Science for Elementary Teachers, a required course in the elementary education curriculum at St. Cloud State College. The subjects enrolled in one of three sections of the course and the intact sections were randomly assigned to one of three treatment groups. Group one was given an investigator-developed comparative advance organizer prior to instruction in the metric system while the second group was given an investigator-written historical account of the development of the metric system prior to the introduction of the metric system materials. The third group received neither an introductory passage nor instruction in the metric system. It was used for control purposes only.

All of the students in each treatment group section were subdivided according to ability and cognitive structure. The average GPA and average cognitive structure for each treatment

group was determined. Those subjects with above average GPA were assigned to the high ability subgroup while those subjects with below average GPA were assigned to the low ability subgroup. In a similar manner those subjects with above average cognitive structure were assigned to the high cognitive structure subgroup while those subjects with below average cognitive structure were assigned to the low cognitive structure subgroup.

The effectiveness of the comparative advance organizer was examined by determining how well the subjects learned and retained metric system concepts using the McFee Metric Test.[8] The McFee Metric Test is a forty-item, four option, multiple choice test which was developed by E. E. McFee to measure the ability of subjects to perform tasks using metric measures and to make intuitive judgements about metric measures. The first twenty items, the proficiency subtest, measures the subjects ability to perform tasks using metric measures by transferring from one metric unit to another metric unit. Questions twenty-one to forty constitute the intuitive subtest which measures the ability of the subjects to make intuitive judgements about metric measures. The scores achieved by the subjects on the intuitive and proficiency subtests on the McFee Metric Test and the total test score were used as criterion measures.

The procedures used in this study involved pretesting, study of the experimental introductory passages, participation in classroom learning activities, posttesting, and the administration of the delayed posttest. The McFee Metric Test was administered as a pretest prior to the introduction of the experimental passages to establish the initial experimental conditions.

Following the pretest, the comparative advance organizer group and the historical introduction group were given their respective passages to read and study. The subjects in these two sections then completed the metric system learning activities. Immediately after the completion of the metric system learning activities, all three treatment groups were administered the posttest to determine the effectiveness of the experimental passages in learning metric system concepts. After a period of thirty days had elasped, the delayed posttest was administered to all three treatment groups using the McFee Metric Test to determine the effectiveness of the introductory passages in aiding the retention of metric system concepts.

The scores on the pretest, the posttest, and the delayed posttest were analyzed using a 2 X 2 X 3 analysis of variance. When significant F ratios were obtained, the Scheffe Test[9] was used in a post hoc partitioning of the sum-of-squares.

ANALYSIS AND RESULTS

The scores achieved by the three treatment groups on the posttest and the delayed posttest were evaluated with repect to student ability and cognitive structure to determine the effectiveness of the comparative advance organizer in the learning and retention of metric system concepts.

The results of the posttest were used to determine the effectiveness of the comparative advance organizer in learning metric system concepts. The first hypothesis tested was:

Hypothesis 1

There is no significant difference in the level of concepts attainment by the subjects in the treatment groups as measured by the posttest scores.

Table 6 shows the results of the analysis of variance as applied to the posttest scores. Of the resulting F ratios, proficiency subtest-2.99; intuitive subtest-1.77; and total posttest score-3.67, only the total posttest score was significant at the .05 level. The conclusion was drawn that the experimental passages, the comparative advance organizer and the historical introduction, were not effective in the learning of metric system conepts as measured by the proficiency subtest and the intuitive subtest but that both passages were effective as measured by the total posttest score. Hypothesis 1 was rejected for the posttest score but it was accepted for the subtests.

Hypothesis 2

There is no significant difference in the level of concept attainment by high ability students or low ability students as measured by the posttest scores.

Analysis of variance was also applied to the posttest scores to determine the effect of student ability on the level of concept attainment as measured by the two subtests and the total posttest score achieved on the McFee Metric Test. From the analysis of variance (Table 6) it was found that the F values on the proficiency subtest-5.95, the intuitive subtest-6.12, and the total posttest score-12.11 were all significant at the .05 level. The conclusion was drawn that the level of achievement of the high ability students was significantly higher than that of the low ability students on both subtests and for the total posttest score. Hypothesis 2 was rejected.

Hypothesis 3

There is no significant difference in the level of concept attainment by subjects with above average cognitive structures and those with below average cognitive structures as measured by the posttest scores.

The F ratios resulting from the analysis of variance of the posttest scores (Table 6), proficiency subtest-.33, intuitive subtest-.79, and total posttest score-1.06 were found not to be significant at the .05 level. The conclusion was drawn that cognitive structure had no significant effect on the learning of metric system concepts as measured by the McFee Metric Test. Hypothesis 3 was accepted.

TABLE 6.--SUMMARY OF ANALYSIS OF VARIANCE FOR POSTTEST

		Proficiency Subtest			Intuitive Subtest			Total Score		
Source of Var	df	Sum of Squares	Mean Squares	F-Ratio	Sum of Squares	Mean Squares	F-Ratio	Sum of Squares	Mean Squares	F-Ratio
1	1	50.42	50.42	5.96[b]	41.67	41.67	6.12[b]	183.75	183.75	12.11[a]
2	1	2.82	2.82	.33	5.40	5.40	.79	16.02	16.02	1.06
3	2	50.63	25.32	2.99	24.13	12.07	1.77	111.90	55.95	3.69[b]
12	1	4.82	4.82	.57	8.07	8.07	1.18	.42	.42	.03
13	2	19.03	9.52	1.12	21.73	10.87	1.60	72.90	36.45	2.40
23	2	462.63	231.32	27.35[a]	283.60	141.80	20.83[a]	1470.43	735.22	48.45[a]
123	2	55.83	27.92	3.30[b]	42.08	21.04	3.09	105.83	52.92	3.48[b]
Within	48	405.00	8.46		326.80	6.81		728.40	15.18	
Total	59	1052.18			754.84			2689.65		

1 = Student Ability; 2 = Cognitive Structure; 3 = Treatment Group

[a]Significant at the .01 level--F(1,48) = 7.19; F(2,48) = 5.08
[b]Significant at the .05 level--F(1,48) = 4.04; F(2,48) = 3.19

Thirty days after the posttest was administered, all treatment groups were administered the McFee Metric Test as a delayed posttest. The purpose of the delayed posttest was to determine the effectiveness of the comparative advance organizer in the retention of metric system concepts. The results of the analysis of variance of the delayed posttest scores are shown in Table 17.

The fourth hypothesis tested was:

Hypothesis 4

There is no significant difference in the amount of material retained by the subjects in the treatment groups as measured by the delayed posttest scores.

Analysis of variance was applied to the delayed posttest scores (Table 17) to determine the effect of treatment group on the retention of metric system concepts as measured by the McFee Metric Test. The resulting F ratios, proficiency subtest-4.80, intuitive subtest-6.06, and total delayed posttest score-7.50, were compared with the critical value of 3.19 at the .05 level of significance. The resluts of these comparisons indicated that all F ratios were significant. It was concluded that both experimental treatments were effective in the retention of metric system concepts and that the comparative advance organizer was significantly more effective than the historical introduction. Hypothesis 4 was rejected for the proficiency subtest, the intuitive subtest, and the total delayed posttest score.

Hypothesis 5

There is no significant difference in the amount of material retained by the high ability students or low ability students as measured by the delayed posttest scores.

Analysis of variance was also applied to the delayed posttest scores to determine the effect of student ability on the knowledge of metric system concepts retained as measured by the two subtests and the total test score on the McFee Metric Test. From the analysis of variance (Table 17) it was found that, of the F ratios obtained, proficiency subtest-3.23, intuitive subtest-7.09. amd total delayed posttest score-6.63, both the intuitive subtest F value and the total delayed posttest score F were significant at the .05 level. The conclusion was drawn that the level of retention of metric system concepts of the high ability students as measured by the intuitive subtest and the total delayed posttest score. Hypothesis 5 was rejected for the intuitive subtest and the total delayed posttest score but it was accepted for the proficiency subtest.

Hypothesis 6

There is no significant difference in the amount of material retained by subjects with above average cognitive structure and those with below average cognitive structure as measured by the delayed posttest score.

The F ratios resulting from the analysis of variance of the delayed posttest score (Table 17), as applied to cognitive structure, proficiency subtest-1.09, intuitive subtest-1.67, and total

TABLE 17.--SUMMARY OF ANALYSIS OF VARIANCE FOR DELAYED POSTTEST

		Proficiency Subtest			Intuitive Subtest			Total Score		
Source of Var	df	Sum of Squares	Mean Squares	F-Ratio	Sum of Squares	Mean Squares	F-Ratio	Sum of Squares	Mean Squares	F-Ratio
1	1	30.82	30.82	3.23	38.40	38.40	7.09[b]	138.02	138.02	6.63[b]
2	1	10.42	10.42	1.09	1.67	1.67	.31	20.42	20.42	.98
3	2	91.63	45.82	4.80[b]	65.70	32.85	6.06[a]	312.43	156.22	7.50[a]
12	1	2.82	2.82	.29	2.40	2.40	.44	.02	.02	.00
13	2	10.43	5.22	.55	12.90	6.45	1.19	40.03	20.02	.96
23	2	508.43	254.22	26.62[a]	472.43	236.22	43.61[a]	1960.83	980.42	47.08[a]
123	2	31.63	15.82	1.66	61.90	30.95	5.71[a]	171.63	85.82	4.12[b]
Within	48	458.40	9.55		260.00	5.42		999.60	20.83	
Total	59	1144.53			915.40			3642.98		

1 = Student Ability; 2 = Cognitive Structure; 3 = Treatment Group

[a]Significant at the .01 level--F(1,48) = 7.19; F(2,48) = 5.08
[b]Significant at the .05 level--F(1,48) = 4.04; F(2,48) = 3.19

delayed posttest score-.98, were found not to be significant at the .05 level. The conclusion was drawn that cognitive structure had no significant effect on the retention of metric system concepts as measured by the McFee Metric Test. Hypothesis 6 was accepted.

IMPLICATIONS

The results of this study, although conducted within narrow limits, suggest that comparative advance orgainzers have potential that need to be more fully utilized. The evidence presented in this study supporting the use of comparative advance organizers presented prior to the teaching of specific concepts may have significant implications for classroom teachers for the development of instructional techniques and strategies. In addition, future researchers might find that the use of experimental designs which stress long-term retention of concepts, not just their immediate recall, can contribute much to our understanding of the learning and retention process.

REFERENCES CITED

1. Ausubel, David P., The Psychology of Meaningful Verbal Learning, Grune and Stratton, New York, 1963.

2. Ausubel, David P., and D. Fitzgerald, "The Role of Discriminability in Meaningful Learning and Retention," Journal of Educational Psychology, 52, 266-274, 1961.

3. Ausubel, David P., Lillian C. Robbins, and E. Blake, "Retroactive Inhibition and Facilitation in the Learning of School Materials," Journal of Educational Psychology, 48, 334-343, 1957.

4. Ausuble, David P., Mary Stager, and A.G.H. Gaite, "Retroactive Facilitation in Meaningful Verbal Learning," Journal of Educational Psychology, 58, 250-255, 1968

5. Allen, D.I., "Some Effects of Advance Organizers and Level of Retention of Written Social Studies Material," Unpublished doctoral dissertation, University of California, Berkeley, 1969.

6. Schultz, R.W., "The Role of Cognitive Organizers in the Facilitation of Concept Learning in Elementary School Science," Unpublished doctoral dissertation, Purdue University, 1966.

7. Ausubel, David P., "Is There a Discipline of Educational Psychology?" in Readings in School Learning, Holt, Rinehart, and Winston, Inc., New York, 1969, p. 25.

8. McFee, E.E., "The Relative Merits of Two Methodologies of Teaching the Metric System to 7th Grade Students," Unpublished doctoral dissertation, University of Indiana, 1967.

9. Scheffe, H., The Analysis of Variance, John Wiley and Sons, New York, 1959.